



PCT/GB 2003 / 001590

PCT/PTO 09 OCT 2004



INVESTOR IN PEOPLE

The Patent Office

Concept House

Cardiff Road

Newport

South Wales

NP16 8QQ

REC'D 05 JUN 2003

PCT

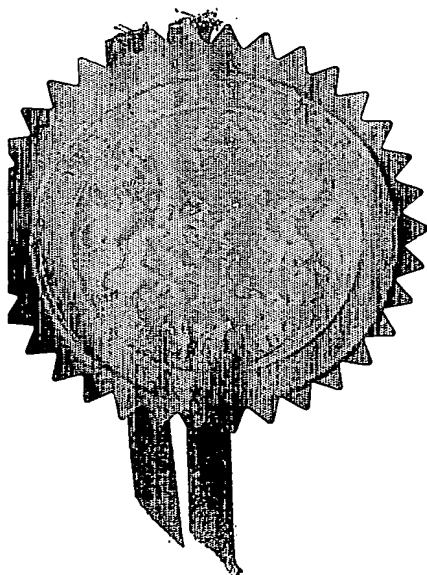
PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH
RULE 17.1(a) OR (b)

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed

He Behen

Dated 19 May 2003

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form).

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference

ABC/20660

2. Patent application number

(The Patent Office will fill in this part)

15 APR 2002

0208619.7

3. Full name, address and postcode of the or of each applicant (underline all surnames)

07645336 001
Patents ADP number (if you know it)

PBT (IP) Limited
1 Astra Centre
Edinburgh Way
Harlow
Essex CM20 2BN

If the applicant is a corporate body, give the country/state of its incorporation

a British company

4. Title of the invention

DRIVE CIRCUIT FOR PIEZO CERAMIC
DEVICE

5. Name of your agent (if you have one)

A A THORNTON & CO

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

235 HIGH HOLBORN
LONDON WC1V 7LE

Patents ADP number (if you know it)

0000075001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country Priority application number Date of filing
(if you know it) (day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
- See note (d))

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

2 ✓

Claim(s)

-

Abstract

-

Drawing(s)

1 only

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

A. A. Thornton & Co.

15/4/02

12. Name and daytime telephone number of person to contact in the United Kingdom

Andrew B. Crawford - 020 7405 4044

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

BEST AVAILABLE COPY

Patents Form 1/77

Drive Circuit for Piezo Ceramic Device

The present invention relates to piezo ceramic devices and more particularly to a drive circuit for such a device.

5 Piezo ceramic devices are now well known but a characteristic of such devices is that in order to achieve high performance levels at low cost, it is necessary to operate at high field strengths. In this operating regime, non-linearity and hysteresis become important factors and their effective management is essential to obtain maximum performance.

10 It is an object of the present invention to provide a drive circuit which reduces the non-linearity effects.

In order that the present invention be more readily understood, an embodiment thereof will now be described with reference to the accompanying drawings in which:-

15 Fig. 1 shows an overall circuit diagram of a drive circuit according to the present invention;

Fig. 2 shows a schematic diagram of a part of the drive circuit shown in Fig. 1; and

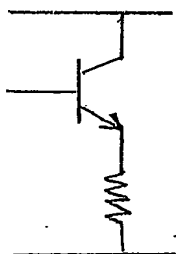
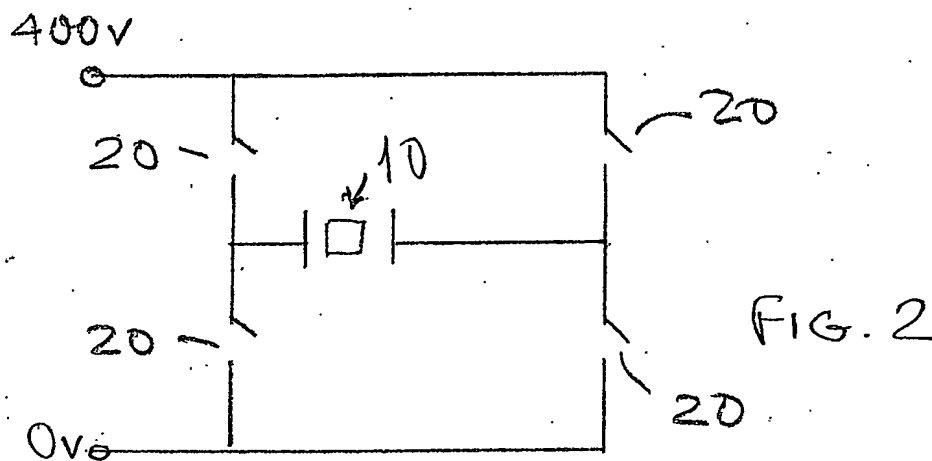
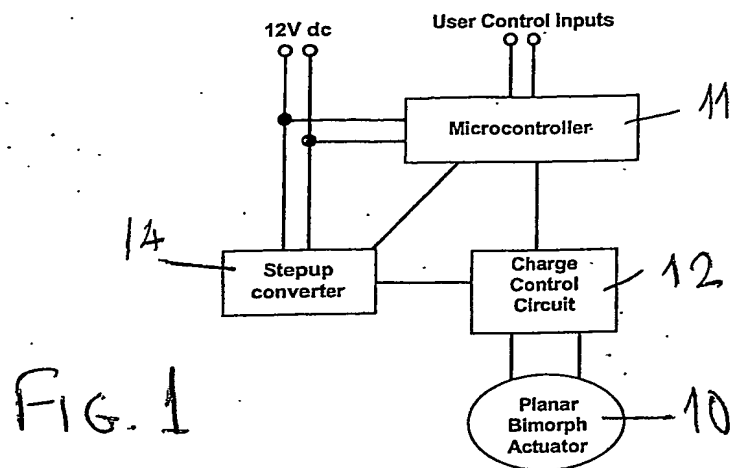
20 Fig. 3 shows a circuit diagram of a switch which is useful in the circuit part shown in Fig. 2.

A preferred embodiment of drive circuit according to the present invention is shown in Fig. 1 where a piezo ceramic device, in this case a planar bimorph actuator 10 is driven by a micro controller 11 via a charge control circuit 12. The charge control circuit is supplied with power from a 12 volt dc
25 supply via a step-up converter 14 which provides high voltage to the charge control circuit. The voltage output from the step-up converter is of the order of 100 to 600 volts preferably in the region of 20 to 400 volts.

The charge control circuit 12 is shown in more detail in Fig. 2 where it will be seen to be basically an H-bridge utilising four switches 20 which are usually operated in pairs to charge and discharge the piezo ceramic device 10.

We prefer to utilise transistor switches figured to operate as current
5 sources for each of the switches 20 and this configuration is shown in more detail in Fig. 3. The use of such switches permits a linear charge to be applied to the piezo ceramic device 10 which in turn produces a linear characteristic when one considers displacement of the piezo ceramic device as compared with the applied charge.

10



THE PATENT OFFICE
19 MAY 2003
Received in Patents
International Unit

BEST AVAILABLE COPY